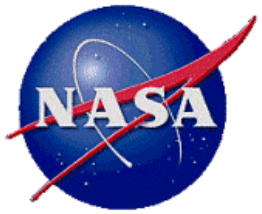

Goddard Space Flight Center

Software Process Improvement at GSFC

How Is ISD Involved?

5/24/04

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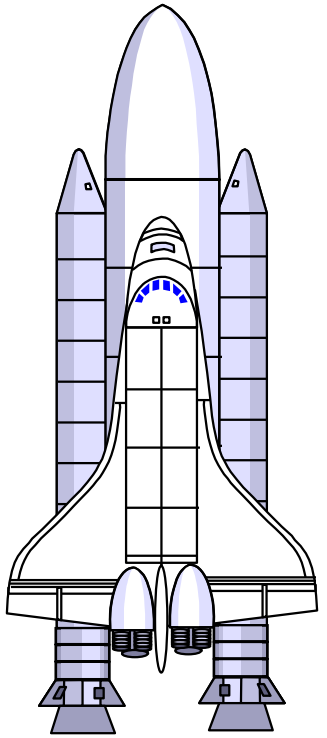
Agenda

- Background
  - NASA Software Initiative
  - GSFC Plan, Improvement Structure, Phase 1
- Phase 2: Implementation
  - Implementation Approach
  - Documentation Structure
  - Web Site
  - Training
- Plans
- Summary



The NASA Software Engineering Initiative

Goal: ***Advance software engineering practices (development, assurance, and management) to effectively meet the scientific and technological objectives of NASA.***

Strategy 1. Implement a continuous software process and product improvement program across NASA and its contract community.

Strategy 2. Improve safety, reliability, and quality of software through the integration of sound software engineering principles and standards.

Strategy 3. Improve NASA's software engineering practices through research.

Strategy 4. Improve software engineers' knowledge and skills, and attract and retain software engineers.

GSFC Software Process Improvement Plan

GSFC has a Software Process Improvement Plan, signed by Al Diaz, 9/01

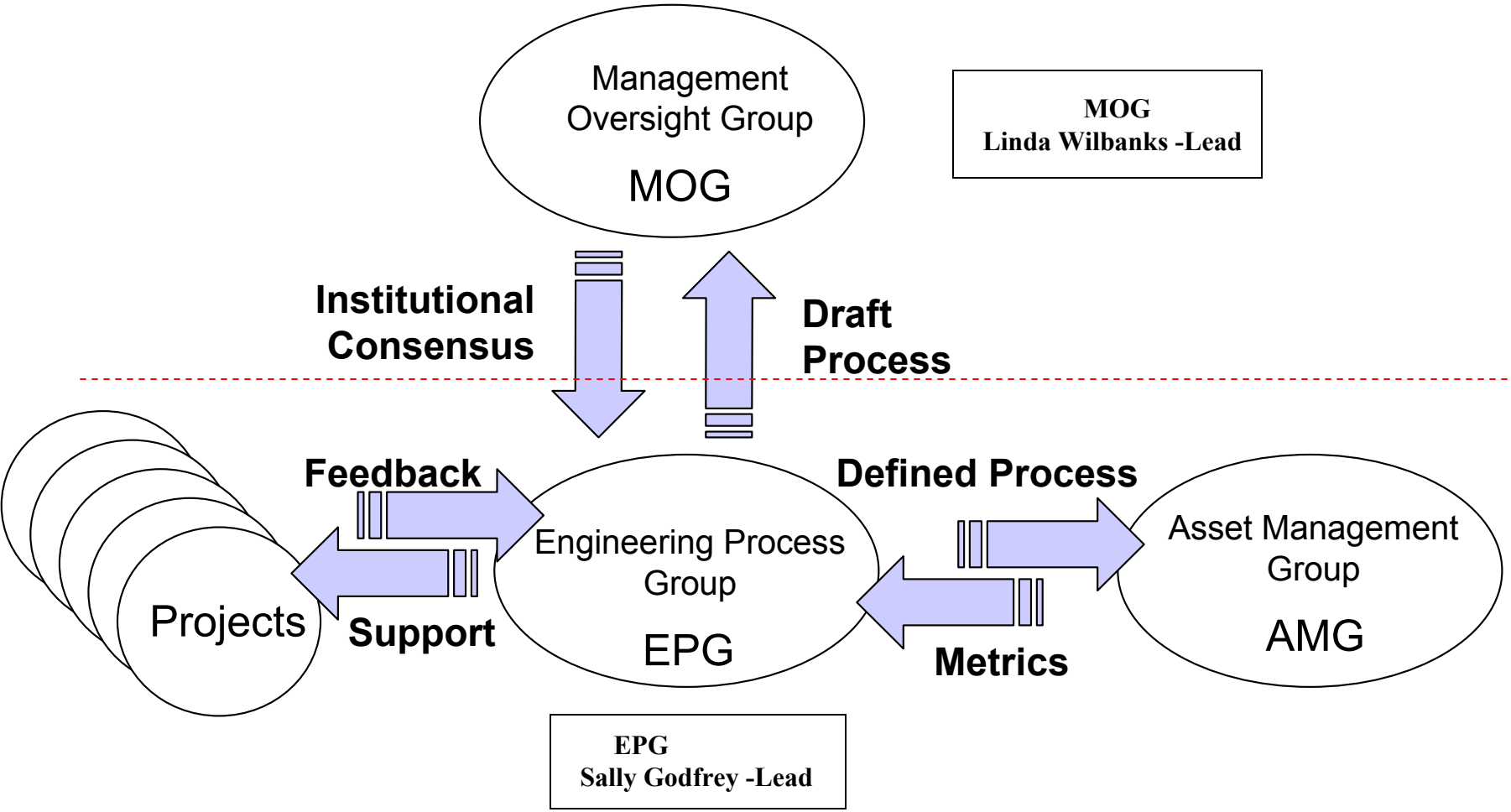
Focus of Plan - **Improve the processes and practices in use at GSFC** using the Capability Maturity Model Integrated (CMMI) as a *measure* of progress

- GSFC Plan primarily addresses Strategy 1 in NASA Plan.
- FY04 Direction by Al Diaz: Achievement of specific CMMI goals

Domain	FY04	FY05	FY06	FY07	FY08
Flight Software Branch		Level 2	Level 3		
ISD & Code 400 Mission Software			Level 2	Level 3	
Any Code 600/900 Mission Software not previously included				Level 2	Level 3

Scope of Plan - All projects defined by NPG 7120.5 (Mission Software) & identified by Center Director will participate in this initial effort

Infrastructure



Implementation Phases in GSFC's Improvement Plan

Phase 1: Pilot Phase (FY02)

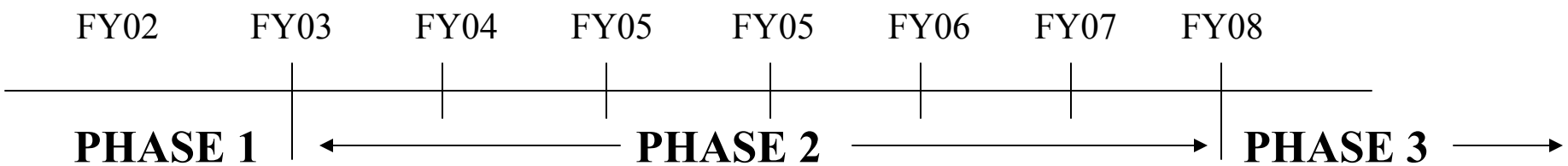
- Benchmark several representative GSFC areas
- Estimate effort, cost to improve identified gaps
- Evaluate implementation approach

Phase 2: Implementation Phase (FY03-FY08)

- Implementation of PI on all critical projects
- Begin by working with new projects to field improvements
- Target CMMI Level 3 for Mission Software

Phase 3: Maintain Level and Continue Improvement

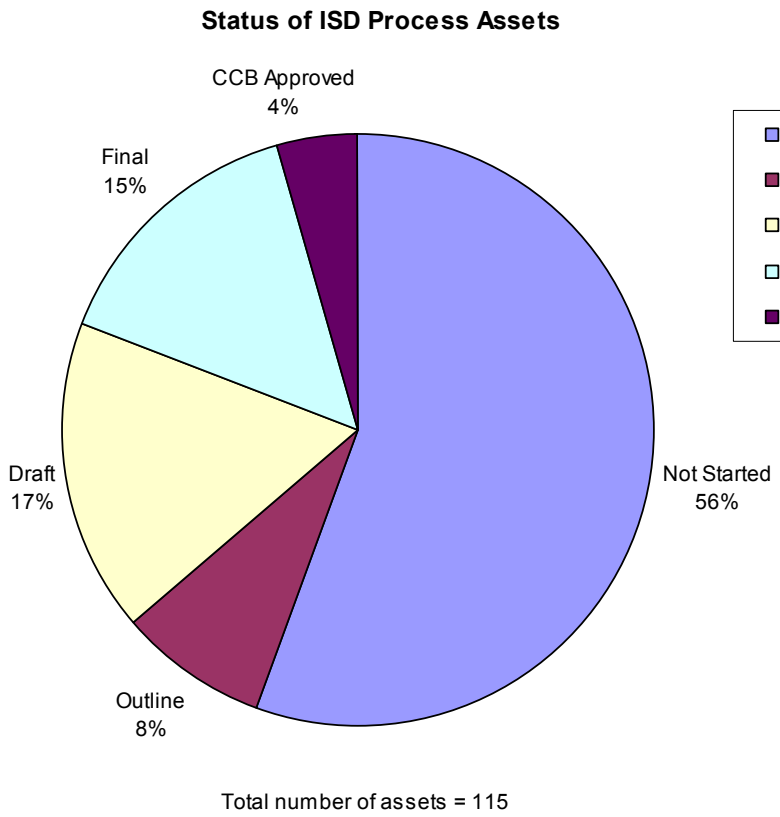
- Include other areas? (e.g. science processing)

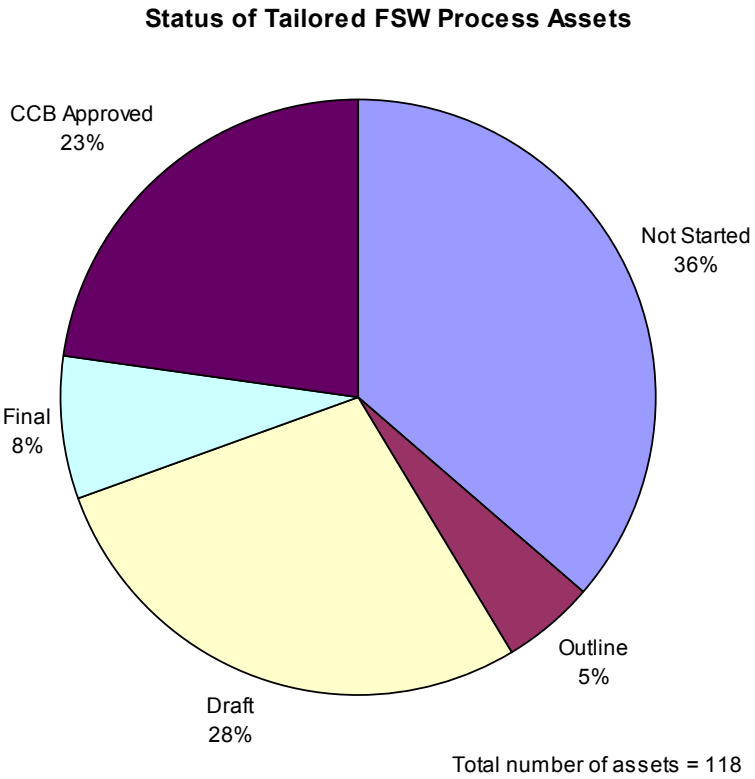


GSFC Phase 2: Focus Activities Beginning FY03

- **Code 582**: Flight Software:
  - Documentation of existing best practices (& suggested improvements)
  - Tools, checklist, templates to support consistent use of practices (e.g. requirements inspection procedures, test plan/procedure templates)
  - Training to support use of improved practices
  - Identification & support for collection/analysis of measures
- **Code 580**: Using flight software practices as a basis, best practices will be documented for all of ISD with assoc. work products & training
  - Consistent approach to planning and tracking (WBS, Earned value, Risk Management)
- **Code 590**: Have worked with NASA systems engineering group to pilot use of CMMI for systems engineering appraisals (JPL was first pilot)
- **Code 400**: Software Acquisition improvements beginning with developing improved RFP templates for software - Review at JPL/GSFC QMSW workshop
- **Code 300**: Began improvements in Software Assurance

Summary-Process Documentation Development Progress (FSW & ISD) as of April 13, 2004





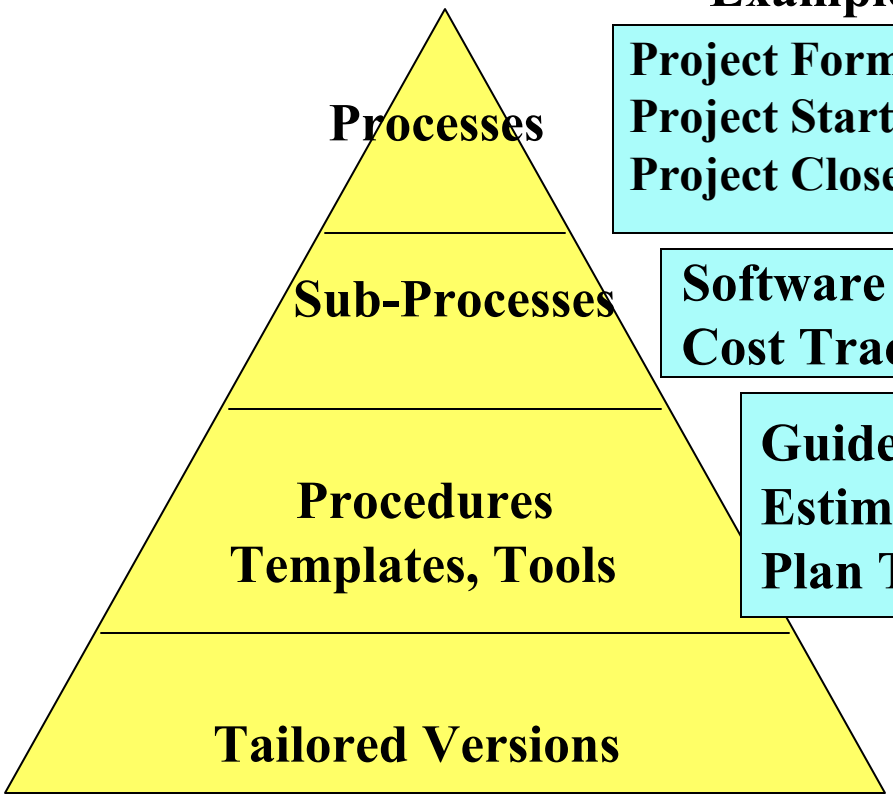
Overall Concepts- Documentation

- Will be a "generic" set of procedures/processes for ISD/GSFC
- "Generic set" will be tailored for Branches (FSW) or classes of software (e.g.-ground systems, science processing, research…) Must use Tailoring Guidelines.
- Projects can also tailor, based on tailoring guidelines
- ISD/GSFC documentation will be on EPG web site
  - Branch tailored documentation can be on Branch web sites
  - Web sites will include use-aids: checklists, templates
- Training and tools will be available with processes

Process Documentation Structure-Top-Down View

Documentation is divided into three Process categories: Project Management Processes, Product Development Processes, Organizational Support Processes

Examples from Project Management:



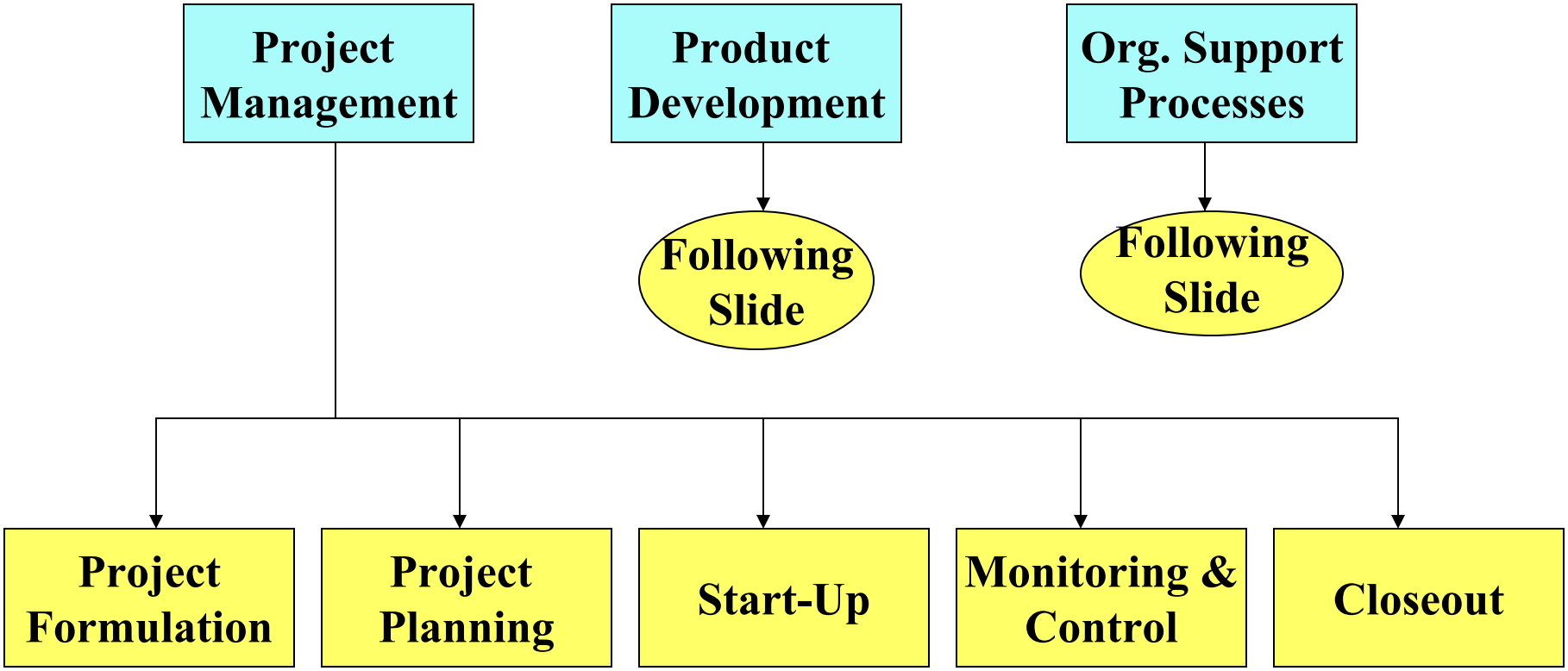
Project Formulation, Project Planning, Project Start-up, Project Monitoring & Control, Project Closeout

Software Estimation, Risk Management, Cost Tracking

Guidelines for selecting a life cycle, Software Estimates/Actuals Database, Risk Mgmt. Plan Template

FSW Standard Life Cycle, FSW Risk Management Procedure

Description of Processes to be Documented



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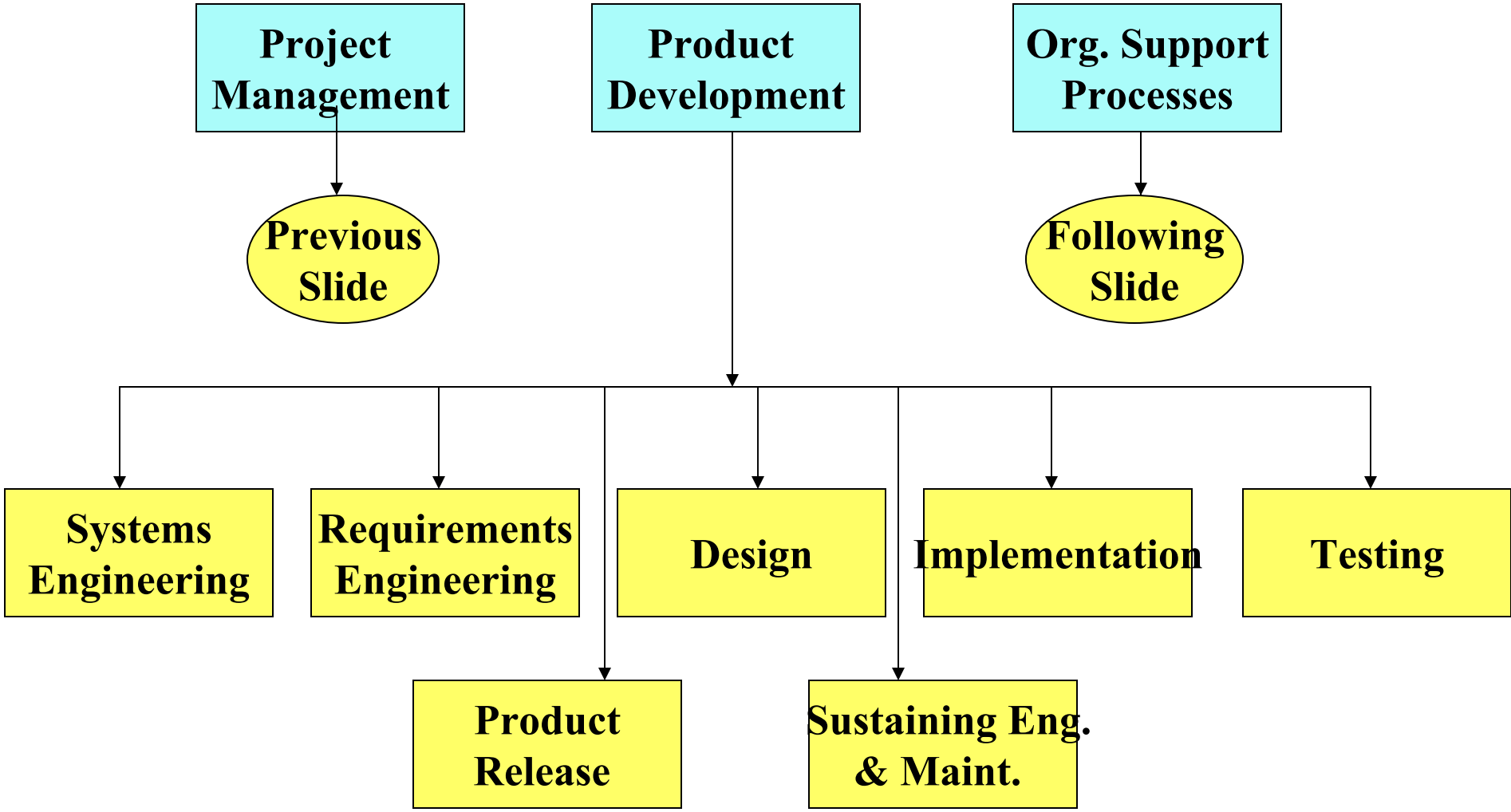
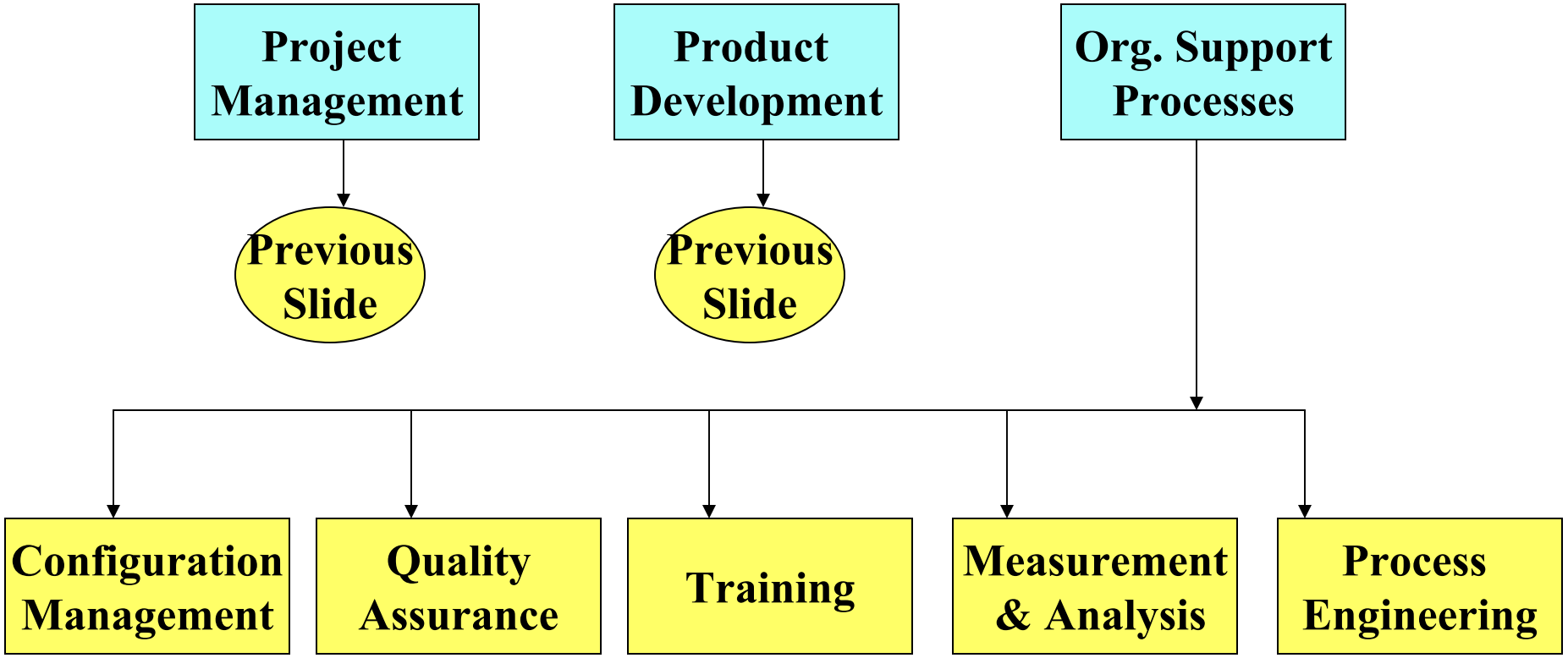


Description of Processes to be Documented



Process Asset Library

+About the PAL
+PAL Feedback Form
+PAL Help
+Glossary

PAL Contents

+Project Management
+Product Development
+Organizational Support

+PAL Index
+Assets by Role
+Assets by Tailoring
+Assets by Type

+Policies
+Standards

Welcome to the GSFC Process Assets Library

The Process Assets Library (PAL) is the repository for all process assets that have been approved for software development at GSFC. Assets include policy, procedures, process descriptions, document templates, guidelines, standards, checklists, and tools.

The initial set of assets has been developed for ISD, but will ultimately be augmented to serve all GSFC projects.

PAL assets may be assessed in multiple ways. The following table shows how these access routes, or "views" can help you find the assets you need.

View	What the view provides
Contents	A table of contents for the PAL
Index	An alphabetical index into the PAL
Role	A list of the roles of personnel working on a typical software project, showing the process assets needed by each role and training courses for each role
Tailored	A set of process assets that have been created or "tailored for use on a specific project or in a specific domain
Description	High level descriptions of the 3 asset categories & the processes they contain
Asset Type	A set of all assets of the same type; e.g., all "templates" or all "checklists"

Software Training Associated with Process Improvement

Audience	Focus	Approach
Community/Others Interested	General Awareness	-Overview info on CMMI, improvement initiative -Lectures, teas, overview classes
Developers/Team Leads	ISD/GSFC specific practices	-Role-based approach -Train on documented procedures, guidelines, templates
Developers/Team Leads	Discipline expertise	-Focus on general skills -University classes, 3rd party classes, teas, conferences
Software Customers	Products, Software/ Customer Interface	-Emphasis on products delivered & needs for producing products -Use of products

Progress Highlights in FY03/FY04

- Flight Software:
  - FSW "Standards" CCB; 27 products baselined and available
  - Are developing products "in-time" to meet project needs
  - Products in use on all new FSW projects, some existing
- ISD/Code 400:
  - Have ISD CCB for processes; 7 products baselined and available
  - Have developed templates for software parts of RFP's
  - Have developed a class to help project managers manage software
  - Have sponsored classes in inspections, software configuration management, software safety, software acquisition, quantitative project management
- Code 300:
  - Have developed processes and checklists
  - Training for better software assurance

Plans for FY04/FY05

- First pre-appraisal in mid-August on Flight Software: Plan to look at (gap analysis):

Project Planning	Project Monitoring & Control
Requirements Management	Requirements Development
Configuration Management	Software Assurance
Risk Management	Organizational Process Focus

- Target SCAMPI (formal appraisal) in October for a few process areas
- Rest of level 2 processes for FSW in FY05, some of level 3 processes
- Will phase in level 2 processes for ISD ASAP, target capability level 2 appraisal in FY05

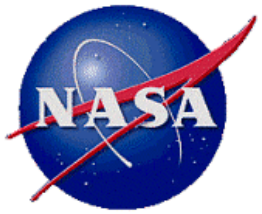
Summary

- GSFC is moving forward to improve our software processes and products using CMMI as an improvement model

- Check out our web site for new features and processes---
  You will need to be following these processes

  http://software.gsfc.nasa.gov

- Look for upcoming classes:
  Quantitative Project Management -June 15, 16
  IEEE/EIA 12207 Class & Workshop (for Acquisition) -July
  Software Project Management -September
  Software for Project Managers - June/July



Back-up Slides

What is CMMI?

The Capability Maturity Model Integrated (CMMI) is an **integrated framework for maturity models** and associated products that integrates the two key disciplines that are inseparable in a systems development activity: software engineering and systems engineering.

A **common-sense application** of process management and quality improvement concepts to product development, maintenance and acquisition

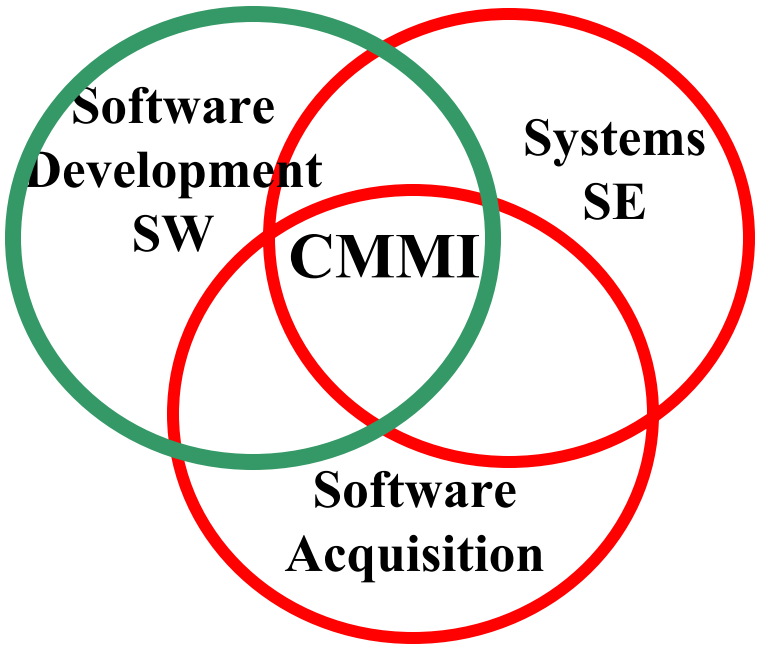
A set of **best practices**

A **community developed** guide

A **model for organizational improvement**

CMMI divides capabilities into 5 levels (5 highest)

GSFC Goal of achieving level 3 as beneficial



What is CMMI? What do levels of software engineering maturity mean?

Level	Description	Process Areas	Result
Optimizing 5	**Improvement institutionalized- routinely fed back into the process**	Causal Analysis & Resolution Organizational Innovation & Deployment	**High Productivity & Quality**
Quantitatively Managed 4	**Product and process are quantitatively controlled**	Organizational Process Performance Quantitative Project Management	
Defined 3	**Software engineering and management processes defined and integrated - processes standardized**	Organizational Process Focus Organization Process Definition Organizational Training Integrated Project Management Technical Solution/Product Integration Integrated Supplier Management Verification/ Validation Risk Management Decision Analysis Resolution	
Managed 2	**Basic project management in place; performance is repeatable**	Requirements Management Project Planning Project Monitoring and Control/ Supplier Agreement Management Process & Product Quality Assurance Configuration Management Measurement & Analysis	
Initial 1	**Ad Hoc**	Processes are informal and unpredictable	**High Risk**

Source: Software Engineering Institute

CMMI and ISO

ISO is a standard, CMMI is a model

ISO is broad- focusing on more aspects of the business. Initially for manufacturing

CMMI is "deep"- provides more in-depth guidance in more focused areas (Software/Systems Engineering/Software Acquisition-SW/SE/SA)

Both tell you "what" to do, but not "how" to do it

But CMMI tells you what "expected" practices are for a capable, mature organization

CMMI provides much more detail for guidance than ISO by including an extensive set of "best practices", developed in collaboration with industry/gov/SEI

-CMMI provides much better measure of quality of processes; ISO focuses more on having processes

-CMMI puts more emphasis on continuous improvement

-CMMI allows you to focus on one or a few process areas for improvement (It's a model, not a standard, like ISO) --Can rate just one area in CMMI

-CMMI and ISO are not in conflict: ISO helps satisfy CMMI capabilities; CMMI more rigorous

Process Area Name	Abbr	ML	FY04	FY05	FY06	FY07	FY08
Requirements Management	REQM	2					
Measurement & Analysis	MA	2					
Project Monitoring & Control	PMC	2					
Project Planning	PP	2					
Process & Product Quality Assurance	PPQA	2					
Supplier Agreement Management	SAM	2					
Configuration Management	CM	2					
Decision Analysis & Resolution	DAR	3					
Product Integration	PI	3					
Requirements Development	RD	3					
Technical Solution	TS	3					
Validation	VAL	3					
Verification	VER	3					
Organizational Process Focus	OPF	3					
Organizational Process Definition	OPD	3					
Integrated Project Management	IPM	3					
Risk Management	RSKM	3					
Integrated Supplier Management	ISM	3					
Organizational Training	OT	3					

Key

Reviewed	
Capability Level 2	
Capability Level 3	

Table B-1: Process Area Schedule for Flight Software

Process Area Name	Abbr	ML	FY04	FY05	FY06	FY07	
Requirements Management	REQM	2					
Measurement & Analysis	MA	2					
Project Monitoring & Control	PMC	2					
Project Planning	PP	2					
Process & Product Quality Assurance	PPQA	2					
Supplier Agreement Management	SAM	2					
Configuration Management	CM	2					
Decision Analysis & Resolution	DAR	3					
Product Integration	PI	3					
Requirements Development	RD	3					
Technical Solution	TS	3					
Validation	VAL	3					
Verification	VER	3					
Organizational Process Focus	OPF	3					
Organizational Process Definition	OPD	3					
Integrated Project Management	IPM	3					
Risk Management	RSKM	3					
Integrated Supplier Management	ISM	3					
Organizational Training	OT	3					

Key

Reviewed	
Capability Level 2	
Capability Level 3	

Table C-1: Process Area Schedule for ISD/Code 400 Mission Software

Phase 1: Piloting FY02

- Conducted 3 sets of CMMI pre-appraisals
  - Appraisals were quick-look, Class B, C appraisals
  - Purpose of appraisals:
    - Evaluate use of CMMI, get better estimate of effort/ cost
    - Get a benchmark against CMMI model, identify gaps
- Sets of projects for pre-appraisals:
  - 2 flight software in-house led teams (included contractors)
  - 3 spacecraft projects (2 largely contracted, 1 in-house)
  - 2 ground support software in-house led teams
- CMMI appraisals identified a number of gaps that were independently identified
  - Actions from Code S/Y Colloquium produced a similar list
  - Plans for Phase 2 were based on findings from Phase 1

Features of SoftwareTraining Web Page

Training Page Includes:

- Training Program Information
  - Software Classes Calendar & GSFC Training Calendar
  - Role Based Training Matrix
  - On-line Training (self-paced, presentations, etc)
  - Software Certification Information
- Software Conference Information
- "Ask an Expert" Feature
- Training Support Page
  - Help in Developing a Class (Can request new class)
  - Mentoring Information
  - How to schedule a class, Feedback on Classes
- Other Training Links

Other Features of Software Web Site

Lessons Learned web page features:

- "Submit a Lesson"
- Software-Specific Lessons Learned Library with views by roles, categories, phases
- Subscribe/Unsubscribe Features
- Lessons Learned Feedback
- Link to "Experts"
- Questions and Answer Forum

Measurement Repository web site features:

- On-line submission of measures
- Access to Measurement Database (for authorized users)
- Measurement Analysis and Charts
- Guidance in establishing and measurement programs

Phase 2: Strategies (FY03-FY08)

- Will use CMMI SE/SW/SS **Continuous model**-- Early implementation of process areas that benefit us most
- Initial focus on **software** improvement --NASA Systems Engineering Working Group still determining direction
- First software area will be on **in-house flight software,** then **ISD**
- Acquisition improvement activities begin in mid-FY04, gradual phase in
- Assets will be developed **"top-down/bottom-up"**
  - Top-Down: Define high level structure of documentation, training
  - Bottom-Up: Develop low level products for deployment, use FSW best practices to help develop high level process
- Phase in improvements on **newer projects**- Products developed as projects need them
- Project Plan updated for new CMMI goals - in signature cycle